

CARTOGRAPHIC PRODUCTION:LEARNING THOUGHT A REAL PROJECT.

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ABSTRACT

This paper presents the framework and the existent relationship between the subjects of “Cartographic Production” and “Cartographic Projects” of the Engineer degree in Geodesy and Cartography.

The aim is the student learning about the stages of the cartographic production and the treatment of Geographical Databases. In order to achieve it, all the students carry out the design of a management project using attributes like business and viability plans to present the terms and technical conditions to produce cartography. The cartographic office is organized between all the students, creating sections to make a topographic map. Indeed, the same work will be carried out on the subject “Cartographic Projects” by means of Geographical Information Systems (GIS).

In this paper are explained the way the student progressively acquires the theoretical knowledge that he needs to perform a work which is also the result from which the subject is evaluated.

1. INTRODUCTION

Cartographic production subject at the E.T.S. DE INGENIERÍA CARTOGRÁFICA, GEODÉSICA Y TOPOGRÁFICA de la UPV is given on the last year of the Engineer degree in Geodesy and Cartography. The aim of the subject is the students to learn on one hand how to create a new company since the beginning and on another hand to learn all the cartographic production steps.

The student learns how the labour market works, involving him as an active agent of a real project. Among other things, the group work and the multidiscipline are promoted. In this way, the student acquires a commitment and a responsibility inside the group that helps to strength his self-confidence and to be aware that he has performed the production of a map. Taking into account these assumptions, the first task they should perform is to create their own company, between all them. In order to assess them, the students receive several conferences to learn all the steps to follow from the Institute for Companies Creation and Development (Instituto para la Creación y Desarrollo de Empresas, IDEAS) [1], which belongs to the UPV. Subsequently, the whole students must perform a report about the future cartographic company with at less the following points:

General description of the company: general information and data, business lines, comparative evaluation with other companies, required technologies.

- Brief analysis of each business line (Thematic cartographic production, GIS products).

- Marketing plan: market description, competition analysis, predicted invoice, sales planning.
- Investment programme: company location, necessary investment, stocks.
- Organization and staff: organization chart, staff cost.

Once the company is already created, they receive a request for tenders with the corresponding technical requirements in order to perform the topographic map of a municipal district at 1:25.000 scale. The students must stand for the project as a company, and, supposedly compete against others companies, even knowing that their proposal will be the chosen one.

Once that the company has been officially chosen the following steps are the production of the future map. In order to perform it, the work basis followed is the one corresponding to the National Geographic Institute for the production of the National Topographic Map sheets at a 1:25.000 scale.

One of the students must be appointed as the manager of the company and he must be the only mediator between the contracting authority (the teacher in this case) and the allotted company (the students' one) during all the process. The experience proves that several problems appear due to the fact that they must organise themselves as if they were a company and some of them will have to order the rest, even if not all of them have the same opinion. In that way, only the main manager can have meetings with the teacher out of the lectures. He must leak all the remarks from the rest of the students.

The cartographic office must decide in how many steps they will divide the cartographic production[2], taking into account the task complexity. The production was divided on eight steps, each of them with different number of members:

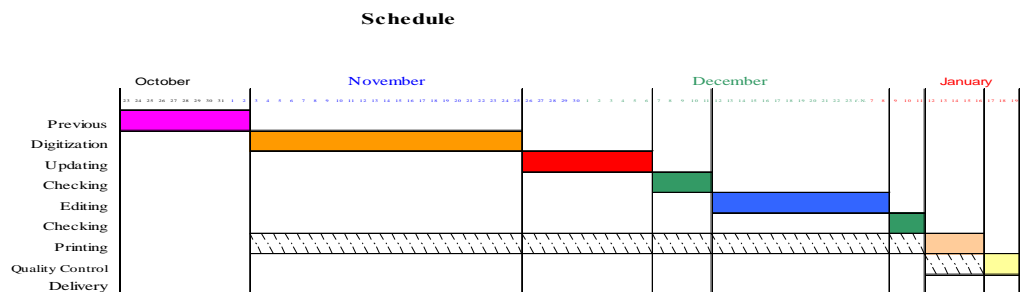
- Previous step. The whole class.
- Verification of the information and the Cartography. 4 students.
- Updating step. 5 students.
- Editing step. 8 students with the help from other groups.
- Checking of the edited work. 4 students.
- Quality control. 2 students.
- Detection of coarse errors. 2 students.
- Printing. 4 students.

Some meetings are organised during the teaching hours to put jointly all the work already done. The students can inform about their doubts or ask the teacher and this allows the rest of the students that are responsible of another step to learn the way the work is done. The meetings are also useful to check if the terms are carried out in each phase and that they are on schedule.

2. PHASES CONTENTS.

The Previous Step is the most important phase of the project, decisive on the success or the final project failure. It basically consists on the project planning, defining clearly the tasks that each group will perform, the development

time for each phase and the connections between them (as well referred to the time, as to the files, maps and codes that will be exchanged).



Before the previous step, each student must know which group he belongs to (with the corresponding manager), and also the person that will be the **main Manager of the project**. This person will be responsible that the work is done on the previous schedule, and that all the Previous Step planning is correctly carried out. Furthermore he has to solve all the problems that will appear during the project, as well as with the exchange problems between groups.

Another important thing is that once that each student knows which group he belongs to, he must learn and get information about its own corresponding phase.

The previous Step will be carried out by all the students of the subject.

As we already mention, during the project course, some round tables where each member explains his impression about the course of the general and the group project, and comments to his classmates about his own work. These meetings are very useful for the student, as in them he learns how to speak in public showing his own opinions and problems. With it he increases his self-confidence, and decreases the fear to speak in public. Besides these general meetings, the students perform other tasks more specifics, where the group managers together with the Main Manager are in charge of studying the common topics of some or all the groups (codes, exchange files, used colours, etc.).

Once this phase has been carried out, each group begin to work in its corresponding tasks, following the schedule.

The next step is the **Verification of the information and the Cartography**, which is carried out by 4 members group. The first task to perform in this step is the research and selection of the project cartography: digital maps at a 1:10 000 scale from the Cartographic Institute of Valencia (I.C.V.). The verification of this cartography lie in the checking of the chosen cartography, which means the suitability of the elements with the corresponding levels according to the appropriate codification and the localisation of digital cartographic errors.

From the initial codification, all the digital observations carried out are indicated. In this way, all the chosen cartography, the codification and the possible errors are informed to next project group in order to make easier and speed up their work.

This phase of the project is performed by 4 students.

The next step, according to the previous schedule is the **Updating phase**. The aim is the correction of all the cartographic errors that are a consequence of the territory transformation during the time. The main work of this group is performed on a field work in the area of Llíria municipal district. Right there, several “doubts reports” are written about the I.C.V. cartography. The same day the students visit the Urbanism department of Llíria council, where the municipal experts deal with showing them the available cartography and with solving the doubts and questions that the verification group has about the toponymy of the place. The urbanism department provide them with soil use and classification cartography, and with several thematic maps. In this step of the project the quality of the cartography is checked with GPS (Global Positioning System), performing GPS observations on outstanding points of it (peculiar buildings, paths, etc.).

The **Verification of the information and the Cartography** Step will be carried out by all the students of the subject.

The **Editing phase** is the one where the information contained on the summary is manipulated and processed in order to represent it according to the symbolization and the generalisation level defined on the cartographic issue standards.

This is the phase with the biggest work volume, and is carried out by 8 students, plus the help from the members of other groups on tasks that can be performed on an independent way to the editing work (shade editing, crop editing, modelling...).

In this editing phase, the steps to perform are:

- Dumping of the information that belongs to the summary.
- Processing of the relief and shade production.
- Processing of the communication network.
- Hydrography processing.
- Building processing.
- Final processing of the soil uses and launch of the plots or superficial patterns.
- Cartographic errors correction.

The used software are mainly **Microstation v.8** and **ArcGis**, but also **ArcView** and **Autocad**, and the way of working is to divide the cartography on a way that each member group works on a fixed set of cartographic elements (communication network, roads, railways, etc.). In this way the students learn much better which is the editing process, strengthening the theoretical knowledge acquired on the Topographic degree. The commitment of this group must be high, knowing that the final success of the project depends highly on their work.

The handling of GIS and CAD software for the cartographic production is highly increased for the students of this subject.

Subsequently, the checking of the **editing work** is performed, from the production group codification received by 4 members of the verification of the information and the Cartography. All the errors are taking down, as well the digital errors from the level, as the founded cartographic errors. The codification received from the other group is also corrected to facilitate the tasks to the printing group.

Once the revision work is finished, and one first map version has been printed at a 1:25 000 scale, the coarse errors must be pointed out on the map itself. Then, these students correct with Microstation (on digital format) all the errors detected by the **quality control** group.

If the number of coarse errors is significant, the map must be directly send to the editing group. The Quality control group, and the coarse errors detection group is consist of 2 members.

The last phase is the **Printing Phase**. The aim of this group is to produce on an analogous format the sheet, at 1:25 000 scale of the municipal district of LLiria. In order to create it, some secondary objectives must be previously performed, as the elements codification, the creation of colours tables and the styles and thickness of the line.

Also, a research is made to choose the convenient printing procedure depending on the sheet characteristics (the first printing was done with Microstation v.8).

This step is not done in one task, as the members of this group must carry out as much printings as requests they have from the members of other previous steps.

This printing phase that is performed by 5 students is the last one of the project and the client acceptance depends on it.

3. EVALUATION OF THE SUBJECT

The used evaluation system is very similar to the one used in the real projects [3].

Since the project has been divided in phases, at the end of each phase a balance should be made of what has been gotten until that moment. Those landmarks have the name of 'check points.'

In the check points an interview with the client (professor) is made to analyze the state of the project. It is a suitable moment to take correction actions or to check that the correction actions applied by the student have been correct. Therefore, the evaluation system is distributed along the whole quarter and located at the end of each phase of the project.

The number of phases and therefore the number of landmarks and evaluations depend on the grade of accuracy with which the student wants to study the contents, that is to say, the students that want to deepen more in the contents will need more phases while the students that opt for a less deep study will require less evaluations.

The way of evaluation of each landmark can be chosen by the student among those proposed by the professor. The conventional exams can be among the evaluation systems, test exams, oral exams, expositions in classroom, etc.

The truly important of the evaluation system is that it provides feedback to the students so they allow to drive in all moment the evolution of the student's learning. If the student begins with not getting the first landmarks he can take the correction actions to end up finally getting the objectives.

This evaluation system also provides a source of external motivation since the student goes seeing in each moment like the plan leave completing and that he comes closer toward the goal.

It is also necessary to highlight that with this evaluation system it is tried not to use the classic system from an only exam to the end of the quarter that can provide unjust marks besides an stress added the student.

Once that the sheet is already done, the student is evaluated according to the following premises:

Delivery of the initial documentation of the tender:

Business plan: from 0 to 10 points

Methodology: from 0 to 10 points

Technical and human equipment: from 0 to 5 points

Execution plan and schedule: from 0 to 5 points

Improvements to the technical requirements of the request for tenders: from 0 to 5 points

Public account: from 0 to 10 points

Round tables: from 0 to 1 point (each one, each student participation is valued)

Work: from 0 to 20 points

Work defence: from 0 to 20 points

Technical and human equipment (contractor evaluation): from 0 to 10 points

4. CONNECTION WITH THE “CARTOGRAPHIC PROJECTS” SUBJECT.

When the main aim is to obtain a printed map, problems appear to obtain digital cartography and data for the GIS. For example, there is lots of information that is captured and is not represented on the printed map. Final user doesn't see all this information. Many other elements that are used in order to get an aesthetic representation of the printed map are unnecessary and must be deleted when loading data on GIS. On the other hand lots of information cannot be loaded on GIS because of CAD limitations [4].

Many of the problems would be solved by changing the production model. Instead of using CAD as the main tool for obtaining cartographic products, the use of GIS tools presents many advantages. For example, when creating the

printed map, many of the operations that are costly with a CAD, are simple to solve on a GIS, because it has specific tools like closing of polygons, fillings allocation, cartographic generalization, management of cartographic projections, tolerances, topologic rules, etc. Besides, GIS stores all the information, graphic and alphanumeric; in this way, the rest of the products obtained from the GIS (topographic and thematic maps, digital terrain models, etc.) are simplifications of this information (Fig. 2).

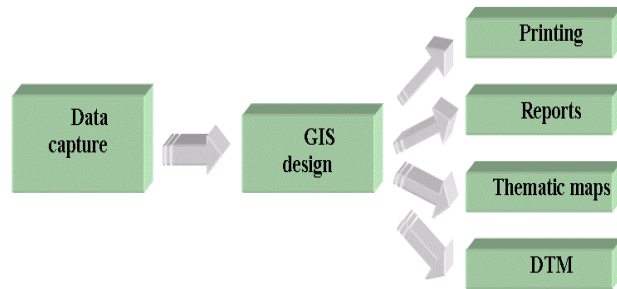
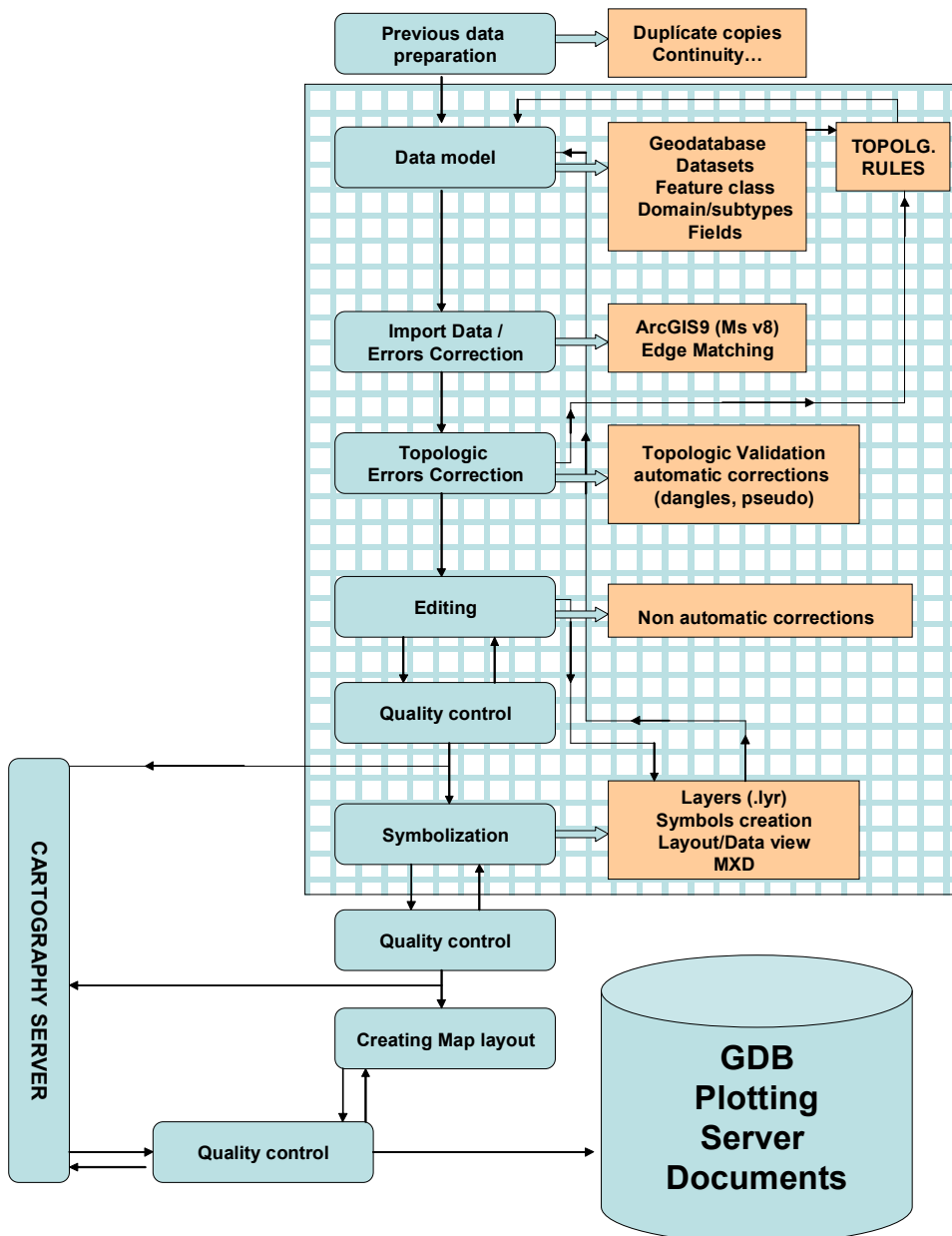


Fig 2 Proposed work flow for cartography publication.



From the CAD format cartography of the traditional production diagram, a data model has been designed, where the appropriate topologic rules has been applied. The subject “cartographic Projects” shows on a useful way to the student the cartographic production using this methodology. For it the project to perform is the same that has been detailed on this paper, and the phases to perform are the following ones:

5.CONCLUSIONS

The positive aspects of this special way of manage the subject are:

- The students improve their capacity to work in group, which is very important for their future on the labour market.
- The classmates known each others better, knowing which students have more involvement degree on the Cartographic project.
- The student commitment is important, knowing that if his work is not correctly done, this affects the rest of the phases.
- The student self-confidence is largely increased. He learns how to be integrated with a team, performing an important task inside the whole project, and all that beginning from zero, as he performs a work scarcely known and he has to learn.. This is really useful as is an analogy of the labour market, where the student learns gradually the daily tasks.
- The knowledge of GIS and CAD software is highly improved, besides the exchange data formats between both systems.
- It helps to define clearly the process of cartography production. The student knows much better which is the staff, means and methodology of the work to use, in case he would want to create a cartographic office.

- He understand on a practical way the problems caused by working without a previous phase where all the people involved on the work known the tasks, the codification to use for every group, and the schedule to work on.
- The student is able to evaluate at the end of the subject how a bad communication between groups can cause misunderstandings and to carry out superfluous work that is not really needed.
- The importance of the involvement of the Main Manager for the success of the project is proved.
- By combining both methodologies (CAD and GIS), the student check that the data used on the traditional cartography production shows that continuity, adjacences and inclusion errors are easy to detect and correct with GIS tools.

The solution contributed in this paper has enough advantages in the teaching of cartographic productions.

On one hand it looks for it that the student assimilates and fix in his memory the fundamental concepts of the cartographic productions. This is made with a practical learning.

On the other hand, it covers the professor's objectives perfectly and of the student [5]. The professor's fundamental objective is the that the student assimilates the concepts and necessary abilities for the cartographic productions. The student's fundamental objective is the one of overcoming the subject to obtain an university degree.

REFERENCES

- [1] www.ideas.upv.es
- [2] Coll, E et al. (2000) Bases Conceptuales para la elaboración del MTN25, Universidad Politécnica de Valencia, SPUPV-2000.999 Valencia
- [3] Gómez-Senent, E. (1997) *El Proyecto: Diseño en la ingeniería*, Universidad Politécnica de Valencia, Valencia
- [4] Martínez, J.C., Coll, E, Irigoyen, J. Aplicación piloto de las necesidades municipales mediante SIG, Revista iberoamericana de Sistemas, Cibernética e Informática, Vol 2, No 2, 2005, <http://www.iiisci.org/journal/risci/>.
- [5] Pozo, J. I. et al. (2002) El aprendizaje estratégico: enseñar a aprender desde el currículo, Santillana, Madrid.